Questions and Comments Related to the Decision Document for the Solar Ponds Groundwater Contamination Plume at the Rocky Flats Environmental Technology Site January 19, 1999

The following questions and comments were received during the Citizen's Advisory Board meeting on January 19, 1999. Responses to those comments were provided at the time and are indicated below, in italics, as "response." Other questions warranted additional research so that a more detailed response could be provided and, in other circumstances, new information has become available which updates the response received during the meeting. Those responses are indicated, in italics, as "expanded responses."

Category 1: Questions That Received a Response During the Meeting

Question: What becomes of the contaminated iron?

Response: If it is judged not to be low-level waste (LLW), it will be recycled; otherwise, it will go into the LLW stream for disposition.

Question: What will be the sampling frequency for the discharge water; where will the laboratory work be done; and what is the lab turnaround time?

Expanded Response: The performance monitoring section (Section 5.5) of the Decision Document has been expanded. Specifically, the section now states:

"Performance monitoring will be conducted to determine the effectiveness of the system in meeting the project objectives. Monitoring of the treatment system will be accomplished by comparing results of the treatment system influent and effluent. Additionally, surface water quality will be monitored at a point of evaluation in North Walnut Creek at a location downgradient of the SPP. The current stream standard for nitrate, 100 mg/L, is a temporary modification to the 10 mg/L water quality standard. The current stream standard is effective through 2009. After expiration of the temporary modification, the stream standard will decrease to 10 mg/L. Preliminary decision rules for the project are presented below. The performance monitoring data will initially be used to evaluate and optimize the treatment system efficiency and effectiveness. As goals for post-closure conditions are established, the performance monitoring data will be used to further refine the decision rules for the treated effluent. Decision rules for this monitoring will be defined and evaluated as a special project within the Integrated Monitoring Program (IMP) and refined as necessary in the final Site Corrective Action Decision/Record of Decision (CAD/ROD).

The schedule for monitoring is shown in Table 5-1. After sufficient data are gathered to demonstrate stable conditions have been achieved, the requirements may be changed to annual or less frequent monitoring.

***Table 5-1.** Schedule for Water Quality Sampling and Water Level Measurements.*

Task	Month 1-6	Months 7-12	Subsequent Years
Treatment System Influent	Monthly	Quarterly	Semi-Annually
Treatment System Effluent	Monthly	Quarterly	Semi-Annually
Downgradient Surface Water Quality	Monthly	Quarterly	Semi-Annually
Hydraulic Head in Collection Trench	Monthly	Quarterly	Semi-Annually

Question: How much water is calculated to be collected from the Solar Ponds?

Expanded Response: The annual flow rate of water collected from the Solar Ponds Plume is estimated to be 2.2 million gallons per year, with the bulk of the flow occurring during the spring.

Question: Does the Rocky Flats Environmental Technology Site (Site) have an accurate picture of both the horizontal and vertical movement of the water? The concern is that water may penetrate below the level of the collection trench. What about water that gets by the treatment system?

Expanded Response: The design goal for the system is to protect the surface water. A small amount of water may get by the system. The bedrock layer will act as a liner to protect against vertical penetration to lower aquifers. The Vertical Migration Study examined the issue of penetration to lower aquifers. The ongoing Actinide Migration Studies will examine the issue of radiological contaminants in groundwater.

Performance monitoring in the North Walnut Creek Drainage will be implemented at station GS13 to monitor changes in surface water quality as a result of the selected remedy. This location was selected because it is immediately downstream of where the groundwater plume intersects the drainage. The loading to the stream will be evaluated to determine long-term system performance and will be reported on an annual basis. In accordance with the Action Level Framework, if the stream concentrations exceed stream standards, then an evaluation will be performed after consultation with the regulators.

If stream standards are being met consistently at GS13 and if simple modeling techniques show that the stream standards would be met without treatment, based on the influent plume concentrations and flow rate, and the stream concentrations and flow rate that exist at that time, then treatment will be discontinued. This system is expected to continue operations until after Site closure when stream flow and concentrations have stabilized. The system will be abandoned in place as a flow-through system. System shutdown will be re-evaluated as part of the final Site CAD/ROD.

Question: Will there be fences around the area?

Response: No.

Question: What prevents the treatment system from overloading during flood conditions?

Expanded Response: Most stormwater and floodwaters will run-off and the effect on the treatment system will be limited by the slow infiltration of the water to below surface areas. The collection trench has an impermeable cover to prevent direct infiltration into the barrier system.

Question: What is the cost of these systems?

Response: The cost estimate is $1.5 million for the installation of the Solar Pond Plume system. Currently, the Site spends $3 million per year for water treatment of the Solar Ponds using an active system.

Question: What about the process lines that have leaked over time? Do they contribute to those contamination plumes?

Response: Contamination from these lines is thought to be in another plume within the Industrial Area. The extent of Industrial Area contamination cannot be known until the

buildings have been removed so samples can be collected below the building foundations. Plans for the Industrial Area characterization plans are still being developed.

Question: What is the length of time that would be required to remediate the plume?

Expanded Response: Based on modeling conducted to support selection of a remedial alternative, it was generally concluded that, without treatment, the potential for exceedance of the nitrate standard (10 mg/L) in alluvial groundwater adjacent to North Walnut Creek exists for greater than 100 years from present. The model is considered conservative in that it did not account for denitrification or natural attenuation of the plume; however, if the simulated condition is realized, the treatment of the SPP could theoretically continue for a minimum of 100 years. The actual timeframe for treatment will be re-evaluated, over time, based on results of monitoring the influent to and effluent from the treatment system (i.e., are natural processes decreasing the contaminant concentrations in the influent to levels which meet the acceptable nitrate levels).

Question: When the reactive iron is used to remove uranium at the Mound Site and the Solar Ponds, what are the disposition plans for the iron when it needs replacement?

Response: It is anticipated that the uranium contaminated iron filings will become LLW; however, the quantity of waste is still uncertain. There also is a possibility that the iron can be recycled. That determination will be made on completion of characterization of the filings.

Question: There has been some discussion of bioremediation using cottonwoods—what has happened with that discussion?

Expanded Response: It was determined that the remediation by cottonwood trees would not be as effective, particularly in the winter. The operation and maintenance costs were high, and water would need to be collected and spread over a wider area than it is presently to allow space for the number of trees required. The plume would have to be captured and supplied to the tree roots. This would greatly increase the cost of the project and disperse the plume beyond its current footprint.

Question: Some Board members were under the impression that there are more contaminants in the Solar Ponds plume than just nitrates and uranium. What are some of the other contaminants and how will the treatment system treat them?

Expanded Response: Nitrates and uranium are the contaminants of concern in the SPP. Although exceedances of surface water standards and action levels are noted in the text of the Decision Document, an analysis of contaminant distribution, particularly metals, and occurrence in the SPP indicates that there are no other contaminant plumes migrating from the Solar Ponds. As a result of the evaluation, coupled with the fact that nitrate is the most prevalent contaminant of concern for the plume followed by uranium, treatment of other contaminants in the SPP was not considered a necessity. However, it is recognized that for the system to be effective the reactive media must be capable of removing metals, whether they are naturally occurring or waste related, from contaminated groundwater. Concentrations of metals in the influent to the treatment system were considered during treatment system design if there is a potential the metals could impact system effectiveness. Site "background" groundwater were used in the studies. Additionally, studies which evaluate metals removal by using iron (Cantrell et al. 1995) and organic (i.e., peat or sawdust) media (Morrison and Spangler, 1992, 1995) indicate that the metals reacted similarly to uranium (i.e., metals were effectively removed from solution primarily by sorption, reduction, and/or precipitation mechanisms.)

Treatment of metals is an added benefit of selecting the reactive barrier as the preferred alternative.

Question: Are there any 3D groundwater maps showing movement of groundwater contamination both horizontally and vertically?

Expanded Response: A 3D map illustrating the plume has not been produced because it is felt that the project resources are better spent moving towards remediation. Additionally, the SPP in its present configuration is not a good candidate for illustration using 3D mapping techniques because the plume is too shallow. Modeling tools used in the analysis of alternatives incorporated a 2D analytical horizontal plane plume model and a 2D numerical vertical plane flow and transport model.

Question: The proposed trench for the Solar Ponds remediation does not fully cover the extent of the plume and a large quantity of the plume will bypass the barrier. How will that be mitigated?

Expanded Response: The collection trench will penetrate 10 feet into the weathered bedrock, thus minimizing any potential for underflow. Additionally, the barrier has been extended southwest on the north side and a well cluster to the north of the barrier will be installed to provide additional data and for performance monitoring purposes. The current ITS will remain and act as a funnel to direct the majority of the plume to the barrier. Where the barrier does not intersect the ITS, the pipes will be sealed on the upgradient side of the wall. The depth of the barrier wall will vary depending on the depth of bedrock (i.e., the depth of the wall will penetrate bedrock to 10 ft), thus minimizing any potential for underflow. Underflow was the primary concern for bypass associated with the ITS because the ITS was not keyed into bedrock. Additionally, performance monitoring wells will be installed and the water quality will be monitored to assess if bypass to the north is occurring.

Category 2: Comments and Concerns Raised During the Meeting

Comment: The plan is good and should be implemented as soon as possible.

Comment: It is better to use maximum flow rates rather than average flow rates; during maximum flow rate times, the time for the chemical reaction with the iron filings will be less.

Expanded and Updated Response: Bench scale tests have been performed using the average annual flow rate because during times of maximum flow, the contaminant concentrations are significantly lower.

Comment: The Site needs to develop a cost/benefit analysis that factors in the stewardship costs associated with maintaining the treatment systems in the future. These complete costs should be compared with the full costs of other alternatives.

Expanded Response: Based on discussions provided in the document Accelerating Cleanup Path to Closure (DOE, 1998), the scope, role, and responsibilities for future Site stewardship remain undetermined; however the Rocky Flats Future Site Use Working Group will be evaluating stewardship issues. As identified in the referenced report, some outstanding issues include identification of a future use management entity, long-term site monitoring requirements, long-term maintenance and surveillance costs, water management for the interim and long-term, and long-term institutional controls. The necessity for maintenance and operation of the reactive barrier will be incorporated into the resolution of these issues.

Comment: The cities of Westminster and Broomfield are concerned about contaminant migration and will closely monitor the migration studies effort.

Response: Comment noted.

Comment: There is concern that the Site doesn't know much about the actual Eh and pH conditions in the area, so how can they accurately duplicate bench scale studies?

Expanded Response: The purpose of the bench scale tests is to simulate the environment which will effectively treat the SPP. Based on the presence of dissolved oxygen (measured in the field during sampling) and the presence of nitrate it can be assumed that the plume is oxidizing; however, because the conditions encountered in the treatment cells are extremely reducing, the Eh and pH of the SPP influent does not influence the effectiveness of the treatment.

Comment: The influent and effluent waters need to be monitored carefully to ensure that the radionuclides are being adequately removed by the treatment system.

Expanded Response: Monitoring of the treatment system will be accomplished by comparing results for groundwater water entering and leaving the system. An access point will be installed to allow sampling inflow to the treatment system. A second access point will be installed to allow sampling of the treatment system effluent. Additionally, downgradient surface water quality will be monitored in North Walnut Creek at a location downgradient of the SPP to assess if RFCA surface water quality standards are met.

Comment: What is the redox potential of the treatment system and the groundwater? If the groundwater has an oxidizing potential, the mobility of U is increased. Concerns were also expressed over the ability of iron to reduce U (VI) to U (IV). How can the bench scale tests be performed while not knowing the redox potential?

Expanded and Updated Response: Based on the presence of dissolved oxygen (measured in the field during sampling) and the presence of nitrate it can be assumed that the plume is oxidizing. Because the treatment media will create a highly reducing environment the redox potential of the influent is not critical. Studies substantiating iron's ability to reduce or remove uranium by sorption, reduction, and/or precipitation mechanisms were evaluated during bench scale test design (Morrison and Spangler, 1992, 1995). Results of the bench scale tests for the SPP indicate that uranium is being removed from solution using both a sawdust/iron mixture and an iron aggregate.

Comment: Concerns were expressed over the determination that the East Trenches have a lower groundwater flow rate, while that at the Solar Ponds is much higher (an order of magnitude). Due to the close proximity of one of the other, the flows should be expected to be more similar.

Response: The Solar Ponds have added flow from Site water usage.

Comment: Concerns were expressed over the ability of the treatment systems to handle higher flow rates as a result of flooding and wet seasons.

Expanded Response: Average annual flow rates were used for system design and bench-scale tests because, during times of high flow the contaminant concentrations are significantly lower. As such, the system will allow overflow to the North Walnut Creek Drainage during periods of high flow without compromising the achievement of the project objectives.

Comment: Concerns were expressed over surface discharge of the Solar Ponds plume through seeps and the contingencies for mitigating any seep impacts to water quality.

> *Expanded Response: While no groundwater measurements are available prior to the installation of the ITS, seeps along the hillslope between the Solar Ponds and North Walnut Creek prior to the installation of the ITS were noted in several studies. Because the barrier will use the existing ITS to direct water to the barrier, the occurrence of seeps associated with the SPP is unlikely.*

References

Cantrell et al. 1995. Cantrell, K.J., Kaplan, D.I., and Weitsma, T.W., 1995, Zero-valent iron for the in situ remediation of metals in groundwater, Journal of Hazardous Materials, 42/2 (Jul 95), pp. 201-212.

Morrison and Spangler, 1992. Morrison, S.J. and Spangler, R.R., 1992, Extraction of uranium and molybdenum from aqueous solutions: A survey of industrial materials for use in chemical barriers for uranium mill tailings remediation, Environmental. Science Technology, Vol. 26., No. 10, pp. 1922-1931.

Morrison and Spangler, 1995. Morrison, S.J. and Spangler, R.R., 1995, Adsorption of uranium (VI) on amorphous ferric oxyhydroxide at high concentrations of dissolved carbon (IV) and sulfur (VI), Journal of Contaminant Hydrology, Vol. 17, pp. 333-346.

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Analysis of Vertical Contaminant Migration Potential, RF/ER-96-0040.UN, August 16, 1996.